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Studies on western Atlantic Octocorallia (Coelenterata: Anthozoa). Part 2: The genus *Callogorgia* Gray, 1858

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Abstract.—Of the three species of *Callogorgia* now recognized in the western Atlantic, one that had been misidentified as *Callogorgia verticillata,* an eastern Atlantic and Mediterranean species, is now established as a new species in its own right, comprised of two subspecies. A second, *C. gracilis,* originally reported from Guadeloupe, is redescribed on the basis of type material and additional specimens. A third species, *C. linguimaris,* is described as new. Records of all three species preserved in the collection of the National Museum of Natural History, Washington, D.C., are reported, and the species are illustrated by scanning electron micrography.

Species of the genus *Callogorgia,* and many other primnoid genera, have some of the most conspicuous polyps and largest sclerites of all octocorals. Their polyp sclerites (scales) are delicately and sometimes ornately sculpted, and arranged in such a definite pattern and number that the total number of polyp sclerites is fairly constant per species and often numbers less than 50. Species occur exclusively in deep water (82–2472 m) and are found worldwide in tropical and warm temperate regions. There are about 26 species known, but only three are currently recognized in the western Atlantic, although several more species remain to be described from this region, as implied by Verrill (unpub.) and personal observations. But, in her report on the octocorals of the western Atlantic, Deichmann (1936) recognized only two species of *Callogorgia* (there spelled *Caligorgia*): *C. gracilis* (Milne Edwards & Haime) and *C. verticillata* (Pallas). The former species is redescribed based on the type and additional specimens; the latter is reidentified as the new species *C. americana*; and a third species, *C. linguimaris,* is described from the Tongue of the Ocean, Bahamas.

Material and Methods

The prominent polyps of *Callogorgia,* which are armor-plated with large, scale-like sclerites, are vulnerable to damage from the moment of collection onwards. Abrasion in the trawl or dredge inflicts some damage, and specimens are obtained in a broken condition, usually with many polyps rubbed off. Handling by the scientific crew under the pressures of sea-going operations results in a second stage of damage incurred during initial preservation in bulk on shipboard. Further attrition occurs in the laboratory during sorting and rebottling procedures. Even in their final containers, most primnoids remain prone to damage with even the most careful handling during scientific study. Each time a specimen is removed from its container more polyps inevitably are broken loose, falling as a calcareous rain to the bottom of the container. It is therefore imperative that not only curatorial personnel charged with maintenance of gorgonian collections, but also the researchers carrying out scientific studies, should handle primnoid specimens as little and as carefully as possible.

Designation of polyp scales used here follows the system employed by Versluys (1906) as modified by Bayer (1982). Synonymies for all species are purported to be complete.

The following abbreviations are used: *CI*—R/V *Columbus Iselin*; *G*—R/V *Gerda*; *JSL-I*—R/V *Johnson-Sea-Link I*; MCZ—Museum of Comparative Zoology, Harvard, Cambridge; *O*—M/V, R/V *Oregon*; *P*—R/V *Pillsbury*; RMNH—Nationaal Natuurhistorisch Museum, Leiden, The Netherlands (formerly Rijksmuseum van Natuurlijke Historie); SEM—Scanning Electron Microscopy (in the context of material examined sections, the specific stub number in the Bayer sequence of SEM stubs); *SB*—M/V, R/V *Silver Bay*; TCWC—Texas Cooperative Wildlife Collection, Texas A&M University; USNM—United States National Museum (now known as the National Museum of Natural History, Smithsonian), Washington, D.C.

Subclass Octocorallia
Order Alcyonacea
Suborder Calcaxonia
Family Primnoidae Gray, 1858
Genus *Callogorgia* Gray, 1858

Diagnosis.—Pinnately branched primnoids with polyps facing upward, always in whorls; polyps curved inward toward axis, with only abaxial rows of body scales complete, those of adaxial rows always reduced in number or absent and leaving most of adaxial body wall naked, those of inner-lateral and outer-lateral rows also reduced in number or absent; distalmost scale in each body-scale row specialized as an opercular scale different in shape from the subjacent marginal scale; abaxial and lateral opercular scales articulating with respective marginal scales near the distal edge so marginals cannot fold inward over operculars. Type-Species: *Gorgonia verticillata* Pallas, 1766, by monotypy.

Remarks.—Examination of over 100 lots from the waters between the Straits of Florida and Surinam reveal the morphological diversity that led Verrill (unpub.) to distinguish five species of *Callogorgia*. Two major types are, indeed, recognizable, one in which the distal abaxial scales of the polyps are sculptured externally with strong, sharp, radially arranged crests, and one in which the scales are externally sculptured more or less distinctly with simple tubercles but never with high crests (although a series of thin radial ridges occurs along the distal inner margin of the scales where they overlap the scale above).

Closer study shows that within these two general types morphological variations occur suggesting the existence of as many as six species. These two types, which possibly represent species-groups, are also recognizable among the Pacific species of *Callogorgia*. To the former belong *C. flabellum* (Ehrenberg), *C. cristata* Aurivillius, *C. robusta* Versluys, *C. weltneri* Versluys, *C. gilberti* Nutting, and *C. kinoshitae* Kükenthal; to the latter belong *C. affinis* Versluys, *C. sertosa* Wright & Studer, *C. minuta* Versluys, *C. similis* Versluys, and *C. chariessa* Bayer. The status of these species remains to be clarified when sufficient material to evaluate variation becomes available for study.

The characters available for discrimination of species remain essentially those used by Versluys (1906), whose exemplary treatment of the Primnoidae of the *Siboga* Expedition placed the classification of the family on a firm scientific basis. These are colonial in form and manner of branching, size and number of polyps in the whorls, spacing of whorls along the branches, sculpturing and number of scales in the longitudinal rows of sclerites on the body of the polyps, and the form and sculpturing of the coenenchymal sclerites.

Unfortunately, these characters, which served reasonably well for the discrimination of species when relatively few specimens were involved, become unreliable when many specimens are available for study.

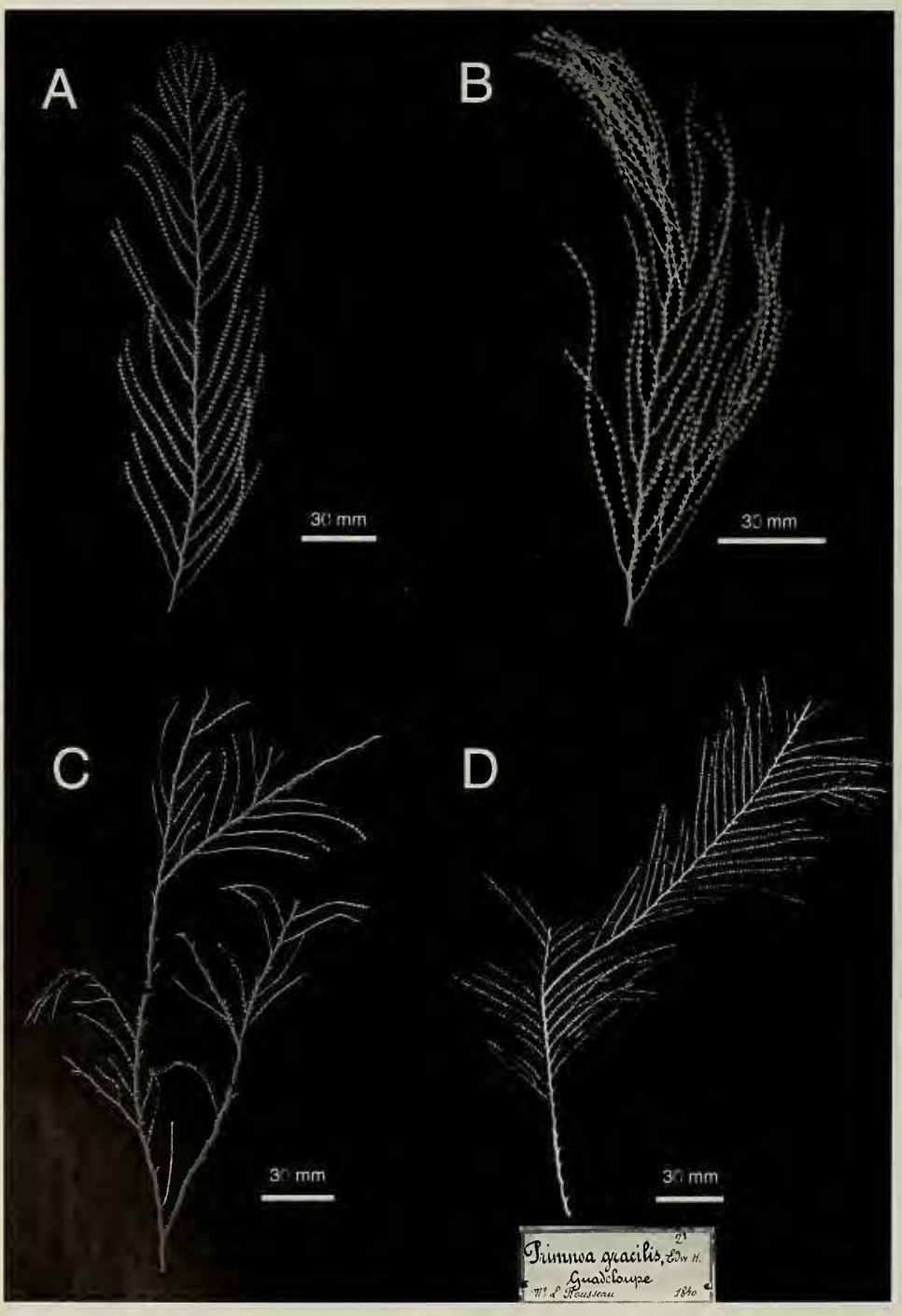

Fig. 1. A, *Callogorgia americana americana,* syntype branch from *P*-889, USNM 52883, × 0.38; B, *C. americana delta,* syntype branch from *O*-3651, USNM 52903, × 0.53; C, *C. linguimaris,* syntypes from *CI*-15, USNM 94580, × 0.36; D, *C. gracilis,* holotype, MNHNP, × 0.34.

1. *Branching.* In the western Atlantic, alternate pinnate branching is the rule, but the group of species corresponding to Deichmann's *C. gracilis* have closer, more regular pinnate branching than do those corresponding to her *C. verticillata,* in which the lateral branchlets are farther apart and the primary axis bends slightly away from each lateral branchlet that is produced, thus assuming a weakly zigzag (quasisympodial) course.

2. *Length of lateral branchlets.* Colonies of the "*gracilis* group" tend to have shorter, stiffer branchlets than do those of the "*verticillata* group," but even among colonies with very similar polyps, some may have long, flexible branchlets while others have short, stiff ones. It is clear that water currents have a significant influence on growth form in other gorgonians, but insufficient data are available for assessment of environmental effects on the form of *Callogorgia* colonies.

3. *Number of polyps per whorl.* On the lateral branchlets, polyps are always arranged with great regularity in opposite pairs or in whorls of three or more; on larger branches, this arrangement may be disrupted by the irregular insertion of new polyps and the loss or resorption of old ones. Some species have a strong tendency toward arrangement in pairs but this is by no means constant and whorls of three or four polyps usually appear on the proximal part of the branchlets. Other species rarely if ever produce polyps in pairs, and the number per whorl tends to increase basally by the insertion of young polyps between mature ones when the diameter of the branchlet becomes large enough to accommodate them.

Addition of polyps on actively growing branchlets occurs both terminally and proximally. New individuals do not necessarily originate simultaneously at the growing tip of branchlets, as branch tips with a single young polyp have been observed. However, in species with polyps typically arranged in whorls, as in *Callogorgia,* two or three young polyps ordinarily occur at branch tips. As the branchlet elongates, the number of polyps per whorl is augmented proximally by the addition of new polyps between the original ones until the maximal number is attained. As the branchlets grow, new whorls of polyps arise between preexisting whorls when space between them becomes sufficient. As young individuals comprising new whorls are usually of similar size, it is apparent that they originate more or less simultaneously, but new whorls with polyps of disparate size have been observed.

The ability to repair damage and regenerate lost polyps is well developed. The common occurrence of regenerating polyps indicates occasional predation, perhaps by fishes, which might nip off individual polyps. Pleurotomariid gastropods have been observed browsing upon colonies of *Callogorgia,* confirmed by recovery of sclerites from gut contents (M. G. Harasewych, pers. comm.). Such browsing might also account for loss of polyps. Detached branchlets that become entangled among branchlets lower in the colony may be cemented in place at points of contact. It is not known how such branchlets might be broken loose in the relatively quiet, deep waters inhabited by *Callogorgia,* but the agency of some predator must be suspected.

4. *Number of whorls per centimeter.* Although a component of most descriptions of species, this character was not used by Kükenthal (1919, 1924) in his keys to the species of *Callogorgia.* Although subject to variation as pointed out by Thomson & Rennet (1931), it is nevertheless a useful clue in the identification of specimens.

5. *Number and arrangement of polyp scales.* The polypal sclerites in genera of primnoids having polyps straight or little inclined or bent toward the axis of the branches are arranged along the body in eight longitudinal rows. The number of scales in the adaxial rows has more or less been reduced owing to shortening of the adaxial side but all eight rows nevertheless

persist at the distalmost part of the polyps even if greatly reduced elsewhere on the body. In most genera the 8 sclerites surrounding the tentacles fold together over the mouth and tentacles as a protective operculum when the polyp is contracted. In genera such as *Callogorgia* having polyps that bend inward toward the axis for protection, the side of the body facing the axis (i.e., adaxial) may have few or no sclerites other than the opercular as there is no room for them when the polyp is shortened during contraction. The abaxial surface, however, remains vulnerable to attack, resulting in the strong development of protective, platelike sclerites. Those of the two abaxial rows are the largest and comprise from 3 to 11 curved scales in each row, extending from the opercular to the base of the polyp. The development of scales in the outer-lateral and inner-lateral row on each side of the body necessary to achieve complete coverage is influenced by the amount of curvature when the body is completely bent inward, and by the width of the abaxial scales.

The outer-lateral rows usually have at least one scale, the "marginal" scale (designated outer-lateral 1), on each side, but in the middle part of the body the outer-lateral tract on each side may be covered more or less completely by a wide lateral extension of some of the adaxial scales ("flügelartige Ausbreitung" of Versluys, 1906:81). The larger outer-lateral 1 is, and the more abaxials that are widened toward the axis, the fewer outer-lateral scales are needed to cover the sides of the polyp.

The inner-lateral tracts may have one scale (inner-lateral 1) on each side but these, too, may be suppressed by enlargement of outer-lateral 1. In colonies whose polyps normally have an inner-lateral 1 on each side, that scale can be replaced either by the broadly expanded basal lobe of the inner-lateral opercular scale, or by a lateral extension of the abaxial 2.

6. *External sculpturing or ornamentation of sclerites.* Wide variation occurs also in the ornamentation of the outer surface of both coenenchymal and polyp sclerites. The fact that immature polyps may have distinctly sculptured body scales while fully grown polyps of the same colony have smooth scales indicates that this character may be influenced by unknown external conditions during development of the individual polyps.

The most pronounced variants would certainly have been treated as distinct species in the past, and might still be so treated save for the degree of intergradation revealed by abundant material from a wide geographical area. Unfortunately, characters that in one species may be stable and reliable, in another may be variable and not diagnostic. This circumstance makes the construction of keys difficult and identification of specimens by their use an uncertain matter at best. Only by side-by-side comparison of all specimens, and evaluation in relation to depth and locality, has it been possible to reach the tentative conclusions here presented to the taxonomic problem posed by this collection. In fact, it remains an open question whether the *Callogorgia gracilis* "complex" consists of two, three, four, or only one species.

Key to the western Atlantic species and subspecies of *Callogorgia*

1. Scales of coenenchyme and polyps with outer surface sculptured with weak to moderately strong radiating, sometimes anastomosing, ridges. Outer-lateral scale rows usually represented by 1 marginal scale, sometimes absent; inner-lateral scales always absent; adaxials usually absent ..... *C. gracilis*

1′. Scales of coenenchyme with outer surface nearly smooth or sculptured with more or less distinct granules radiating from center; distal, abaxial, and outer-lateral body scales externally sculptured with finely serrated crests most conspicuous on marginal scales, gradually decreasing in prominence proximally until scales of basal half of body are smooth or only faintly ridged. Outer-lateral

rows with 1–4 scales; inner-lateral rows with 1–2; adaxial rows usually with 1 scale 2

2. Polyps distinctly clavate, in whorls of 3–7; 4–5 (or sometimes 6) whorls in 1 cm of branchlet; outer-lateral rows of body sclerites always represented by 2–4 scales ... 3 (*C. americana* sensu lato)

2′. Polyps cylindrical, arranged in opposite pairs (i.e., whorls of 2) distally, sometimes increasing to whorls of 3 proximally; 4 whorls in 1 cm; outer-lateral row of body scales with 1–2 scales ... . *Callogorgia linguimaris,* n. sp.

3. Cristate sculpture of abaxial and outer-lateral scales strong and complicated, crests of distalmost 3–4 scales stout, high, often divided into lobes and covering most or all of exposed surface of scale ..... *Callogorgia americana americana,* n. subsp.

3′. Cristate sculpture of abaxial and outer-lateral body scales more delicate and less complicated, consisting of several thin, narrow lobes situated around free margin of scales, leaving remaining surface nearly or quite smooth .... *Callogorgia americana delta,* n. subsp.

Callogorgia americana, new species
Figs. 1A, 2–4

Not *Primnoa flabellum* Pallas, 1766:134.

Not *Gorgonia verticillata* Pallas, 1766:177.

Not *Callogorgia verticillata.*—Gray, 1858: 286.

Primnoa flabellum.—Duchassaing & Michelotti, 1860:17.

Primnoa verticillaris.—Pourtalès, 1868: 130.

Calligorgia americana Verrill, MS, captions of pl. 27, figs. 1a–e; pl. 82, figs. 4, 4a, 4b [unpublished original text].

Calligorgia aspera Verrill, MS, caption of pl. 25, fig. 1 [unpublished original text].

Calligorgia asperula Verrill, MS, captions of pl. 27, figs. 2, 2a, 2b [unpublished original text; labeled as *C. aspera* on bottom of plate].

Caligorgia americana Kükenthal, 1919:372 [nomen nudum].

Caligorgia verticillata.—Kükenthal, 1919: 371–372; 1924:270 (part: records from West Indies).—Deichmann, 1936:159–161, pl. 25, figs. 5–9, pl. 26, fig. 6.—Bayer, 1954:281 (listed).

Callogorgia verticillata.—Bayer, 1956: F220, figs. 158, 4; 159, 2; 1958:388 (in part: *O*-590, *O*-1048); 1961:297, figs. 96a–d (in part: not records off Surinam and Cuba).

Material examined/types (all specimens listed below are considered to be syntypes).—STRAITS OF FLORIDA: off Sebastian Inlet, Florida: 27°59′N, 79°20′W, 586–567 m, *P*-197, 11 Aug 1964, 10 pinnate branches, the largest 42 cm tall, USNM 52890 (SEM 373); 2 pieces of main stem and detached branches, USNM 52882 (SEM 334).

Off Indian River Inlet, Florida: 27°30′N, 79°22′W, 579–569 m, *G*-663, 17 Jul 1965, 5 large branches, the largest over 50 cm tall, USNM 52880.

Off Settlement Point, Grand Bahama: 27°09′N, 79°18′W, 604 m, *G*-386, 19 Sep 1964, piece of main stem broken off at holdfast, and 3 pieces of stem with lateral branchlets, all possibly part of one colony, USNM 52879 (SEM 457).

Off Ft. Lauderdale, Florida: 26°04′N, 79°24′W, 549–512 m, *G*-715, 2 Aug 1965, 1 lateral branchlet, USNM 52884.

11 km off Carysfort Reef Lighthouse, Key Largo, Florida, 204 m, coll. F.M. Bayer et al., M/V *Megalopa,* University of Miami, 8 Jul 1950, 2 incomplete lateral branchlets, USNM 51954.

Off Sand Key, Pourtalès Plateau, Florida, depth unknown, State University of Iowa (Nutting) Bahamas Expedition, Station 29, 4 large branches, USNM 91851.

SSE of Key Largo, Florida: 24°54′N, 80°15′N, 219–212 m, *G*-794, 19 Aug 1966, 9 branches from a large colony, USNM 52881 (SEM 214, 215, 365).

E of Sombrero Key, Florida: 24°24′N, 80°41′N, 296–289 m, *G*-840, 11 Jul 1967, 3 small pinnate branches, USNM 52887 (SEM 332, 463).

Off The Samboes, S of Boca Chita Key, Florida, 200 m, coll. John B. Henderson, Yacht *Eolis,* 1916, 4 fragments, USNM 44131.

Off Key West, Florida: 24°20′N, 82°04′W, 220 m, *SB*-2427, 29 Oct 1960, 6 incomplete lateral branchlets, USNM 52889.

Off Key West, Florida, 183–220 m, coll. John B. Henderson, Yacht *Eolis,* 1916, 3 incomplete lateral branchlets, USNM 44161.

Off Key West, Florida: 24°17′05″N, 81°58′25″W, 242 m, *Fish Hawk* sta. 7280, 14 Feb 1902, several pinnate branches and fragments, USNM 44160.

Off Sand Key, south of Key West, Florida, 200 m, coll. John B. Henderson, Yacht *Eolis,* 1916, 1 poorly preserved specimen, USNM 44159 (SEM 369, 376).

Off Dry Tortugas, Florida: 24°11′N, 83°21.5′W, 732 m, *SB*-1196, 8 Jun 1959, 6 broken branches, USNM 51485.

STRAITS OF YUCATAN: NE of Cape Catoche, Yucatan: 22°40.2′N, 86°36.6′W, 377 m, *O*-590, 12 Jun 1952, 1 main branch and fragments of branches with lateral branchlets, USNM 50850; 27 main branches (dry) USNM 51298 (SEM 456).

NE of Cape Catoche, Yucatan: 22°41.9′N, 86°41.2′W, 411 m, *O*-726, 11 Feb 1953, 1 specimen (dry), USNM 51299 (SEM 459).

Bahia de Campeche, Campeche Bank WNW of The Triangles: 21°17′N, 91°18′W, 37 m, *O*-1048, 13 May 1954, 3 branches badly decalcified by formalin, USNM 50527.

Old Bahama Channel off Cay Sal: 22°59′N, 79°17′W, 458 m, *O*-1343, 16 Jul 1955, 4 pinnate branches, USNM 50185 (SEM 370, 371).

ANTILLES: Mona Passage: 18°16′N, 67°16.5′W, 421 m, *O*-2652, 6 Oct 1959, 2 branches, USNM 51578.

Lesser Antilles off Guadeloupe: 16°33.2′N, 61°36.8′W, 366 m, *P*-944, 17 Jul 1969, 1 apical branch with 9 branchlets, USNM 52868.

Off St. Lucia: 14°05.2′N, 60°50.3′W, 311 m, *P*-891, 7 Jul 1969, 4 large branches, USNM 52885 (SEM 212).

Off St. Lucia: 14°04.4′N, 60°50.8′W, 402 m, *P*-889; 7 Jul 1869, 3 pieces of stem, 3 pinnate branches and several smaller fragments, USNM 52883 (SEM 337, 458, 465); 1 stem, RMNH Coel. 31169.

Caribbean Sea N of Peninsula de Paria, Venezuela: 11°30′N, 62°29′W, 329 m, *O*-2772, 15 Apr 1960, 2 large branches, USNM 58393 (SEM 358, 359, 397).

Caribbean Sea off Isla Tortuga, Venezuela: 11°10′N, 65°07′W, 420 m, *O*-4480, 21 Oct 1963; 1 branch, USNM 52888 (SEM 332).

Specimens reported by Deichmann (1936): *Blake* stations 208, 216, 233, 269, 281.

Diagnosis.—*Callogorgia* with crestlike radial sculpture on outer-lateral and distalmost 2–4 abaxial scales, strongest on marginals and becoming progressively weaker proximad; 7–11 body scales in abaxial rows, 2–4 in outer-lateral rows, 1–2 in inner-lateral rows, and usually 1 in adaxial rows; 4–6 whorls in 1 cm of twig length.

Description.—The plumose, flabellate colonies reach 1 m or more in height, branched in an alternate pinnate manner. Lateral branchlets vary in length from 50 to 150 mm in length, but commonly are 75–100 mm long. The distance between branchlets along one side of the stem (i.e., internodal length ×2) ranges from 7 to 15 mm; rarely, 2 branches originate from one node on the same side of the stem. New lateral branchlets originate only near the apex of the main stems, not between preexisting branchlets. At the origin of each branchlet, the main stem bends a few degrees away from the branchlet, so the stem follows a slightly zigzag course. This is most conspicuous distally, becoming less obvious on the lower parts of the colony where it is obscured by secondary thickening of the primary axes.

Polyps in contraction (Fig. 2) are bent strongly inward toward the axis, clavate,

Table 1.—Distinguishing Characters of the Western Atlantic *Callogorgia.*

Characters	C. americana americana	C. americana delta	C. linguimaris	C. gracilis
Colony shape	Plumose, flexible; quasi-sympodial main branch (zigzag)	Plumose, flexible: quasi-sympodial main branch (zigzag)	Plumose, flexible; quasi-sympodial main branch (zigzag)	Plumose, stiff; straight main stem
Internode distance (one side)	7–15 mm	4–14 mm	10–12.5 mm	4.5–11 mm
Polyp shape and height	Clavate; 1.3–1.5 mm	Clavate; 1.3–1.4 mm	Cylindrical or clavate; 1.1 mm	Cylindrical; 0.9–1.1 mm
Number polyps/whorl	3-6-7	2-3-5	1-2-3	2-3-6
Number whorls/cm	4-5-6	4-6	4	4-6-8
Abaxial sclerite sculpture (exterior)	Tall, complex, finely serrate ridges covering entire exposed surface	Less tall, simple ridges on proximal half surface.	Variable: smooth on branchlets; highly ridged on main stem	Prominent, radiating reticulate sculpture
Abaxial sclerite sculpture (distal edge)	Prominent marginal dentations	Fine marginal serration	Coarse serration	Serrate continuations from inner side
Abaxials (number in a row)	7–11	8–11	5–7	5–8
Outer laterals (number in a row)	2–4 (+)	2–4 (+)	1–2	0-1-2 (+)
Inner lateral (number in a row)	1–2	1–2	1–2	0
Adaxials (number in a row)	1-2	1-2	1	0-1
Opercular sclerites (shape)	Sagittal furrow flanked by tall longitudinal ridges	Triangular but taller	Tall, narrow with low long. ridges	Slightly concave outer surface bearing numerous longitudinal ridges
Distribution	Straits of Florida; Lesser Antilles; 183–732 m	Northern Gulf of Mexico; 366–570 m	Bahamas; 1116 m	Lesser Antilles, Bahamas; Northern Gulf of Mexico; 82–514 m

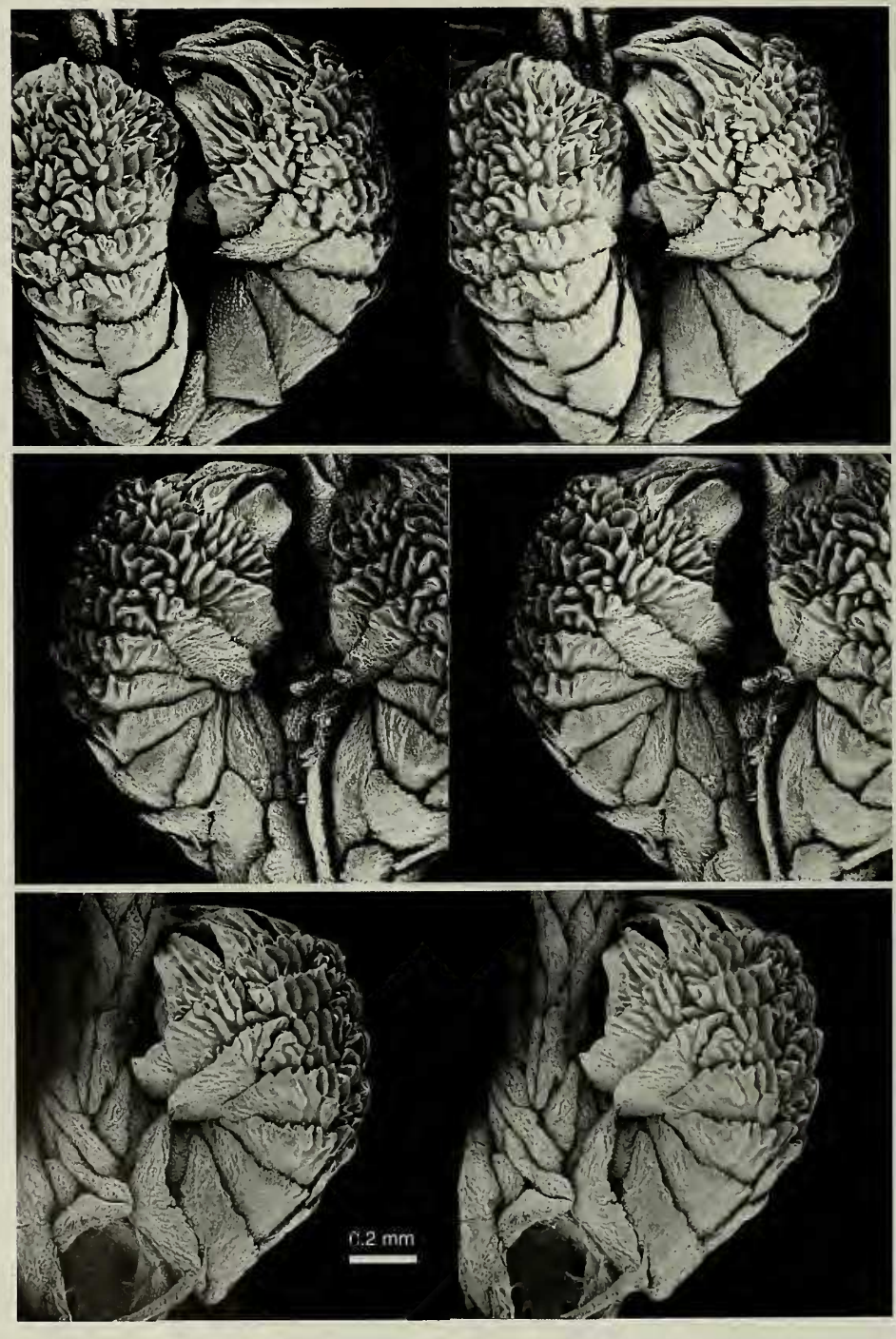

Fig. 2. *Callogorgia americana americana* from *P*-889, USNM 52883: three stereo views of the arrangement of sclerites covering the polyps and stem, scale bar applies to all three views (× 46).

about 1.3–1.5 mm tall, arranged in regular whorls of 3–7, 6 being the most common number. Four to six (usually 5) whorls occur in 1 cm of axial length. Polyps persist on the larger main branches and stems, but there the verticillate arrangement is usually irregular.

All 8 longitudinal rows of body scales are represented, 7–11 scales in the abaxial rows, 2–4 in the outer-lateral rows, 1 or 2 in the inner-lateral rows, but the adaxial rows consist of only one, or sometimes 2, small scales below the adaxial operculars. Rarely there are additional short rows of 1–3 outer-lateral scales adjacent to the most proximal abaxials and thus separated from the other outer-lateral scales that are adjacent to the distal abaxials; however, when the polyp is strongly bent inward, these disjunct sclerites come into contact. The abaxial body scales are usually arranged in pairs across the sagittal axis, but are sometimes slightly offset, and occasionally a small extra scale is intercalated on only one side, making it difficult to accurately count the number in a complete abaxial row. The abaxial (outer) edges of the abaxial scales abut each other or slightly overlap. The most proximal 3 or 4 abaxials are quite wide and curved, almost entirely circling the polyp. Toward the tip of the polyp the abaxial scales dramatically decrease in width, becoming rectangular to square in shape at the polyp margin, the lateral region of the polyp being covered with 2–4 broad outer-lateral scales and 1 or 2 broad inner-lateral scales. These additional short rows of scales produce the characteristic clavate shape of the polyp. The distalmost 4 or 5 pairs of abaxial sclerites bear prominent (up to 0.1 mm in height), finely serrated crests radiating outward from near the middle of the tuberculate proximal border to the distal margin, where they form strong dentations. These crests, which are longitudinally to slightly obliquely oriented, are so tall that they often obscure the boundary between the abaxials and outer-lateral scales. The height of the crests gradually decreases toward the branch, such that the proximal 3 or 4 abaxials are smooth, bearing only small aligned granules or low ridges. The broad outer-lateral scales also bear longitudinal crests, but only on their abaxial portion (adjacent to the abaxials), the remainder of these scales bearing a low granulation. The broad inner-lateral scales have a granular external sculpture. The adaxial scales are square and quite small, located directly beneath the adaxial opercular scales and often overlapped by the adaxial margin of the inner-lateral scales. Below the adaxial scales the polyp is bare, devoid of sclerites, allowing the polyp to fold inward.

The operculum is well developed, the large abaxial and outer-lateral opercular scales forming a prominent, bluntly conical covering over the infolded tentacles, the inner-lateral and adaxial operculars being somewhat smaller. The opercular scales (Fig. 3A–G) are triangular, sometimes with a longitudinal sagittal furrow or crease on the outer surface, which corresponds to a keel on the inner surface. Several prominent, longitudinal ridges on the outer surface radiate from the base, and the inner surface is covered with crowded, complex tubercles. The tentacles contain small, irregularly sculptured rods.

The coenenchymal sclerites (Fig. 3S) are long (up to 0.7 mm), broad (0.10–0.18 mm), flattened rods, sometimes irregularly lobed or branched, with finely granular sculpture on the exposed surface and closely set complex tubercles on the inner, together with some smaller scales with granular or cristate external sculpture. In general, the coenenchymal sclerites are only one layer thick.

Variation.—Specimens of *C. americana* show much less variation than is observed in *C. gracilis*. Although the cristate sculpture of the distal abaxial and outer-lateral body scales varies from rather coarse, as in USNM 52890 from the east coast of Florida, to rather fine, as in USNM 52883 from St. Lucia, most specimens fall somewhere between those extremes. This sculptural

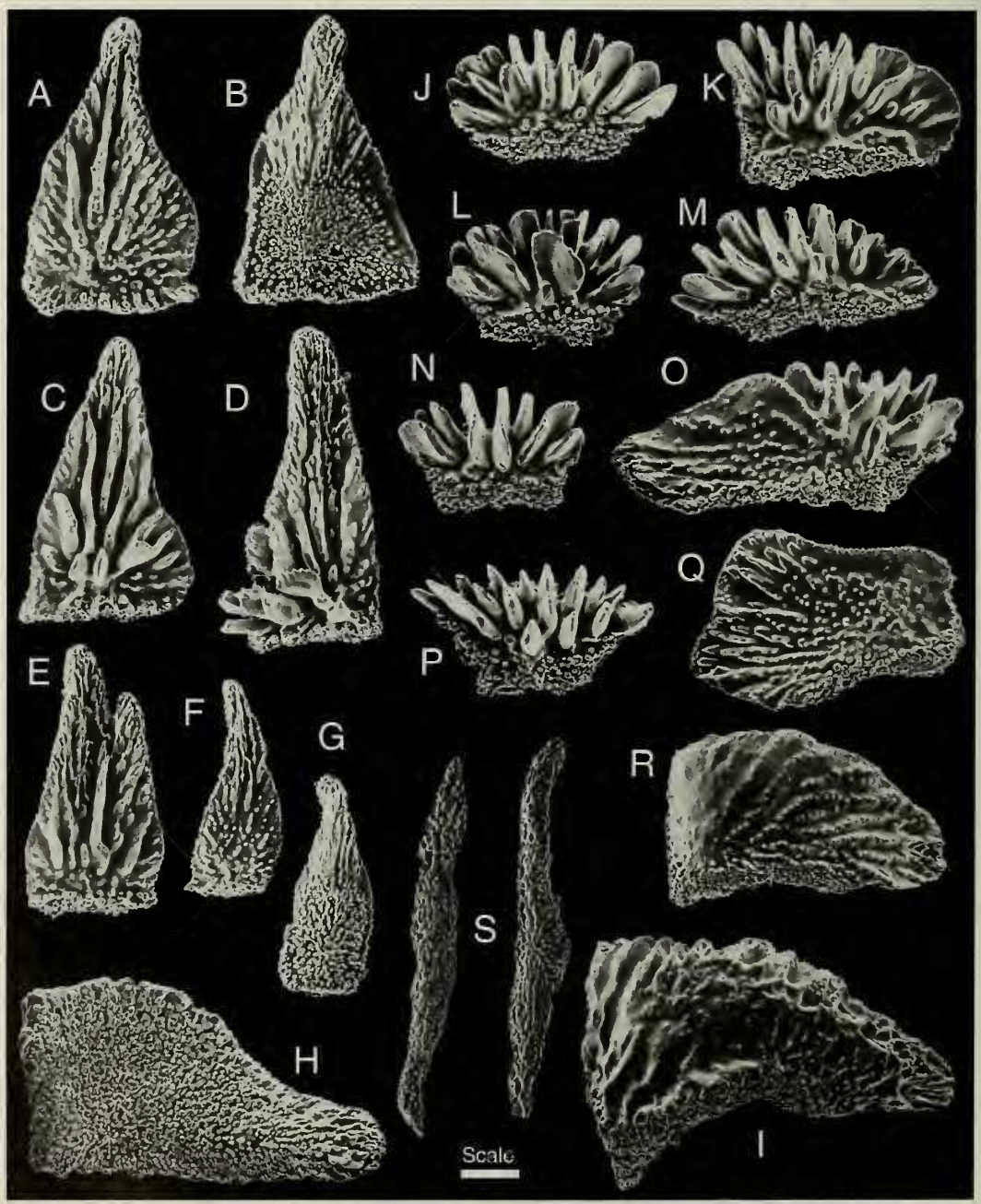

Fig. 3. Sclerites of *Callogorgia americana americana* from *P*-889, USNM 52883: A–G, opercular scales (F–G are adaxial operculars); J, L, N, P, highly ridged abaxial scales near tip of polyp; H–I, abaxial scales near base of polyp; K, M, O, outer-lateral scales; Q–R, inner-lateral scales; S, two coenenchymal rods. All views are of external surface except figures B, G, and H, which are internal surfaces. Scale bar: A–R = 0.10 mm, S = 0.15 mm.

variation seems to have no geographical correlation, as two lots from the same haul (USNM 52882 and 52890) differ as much as do lots from widely separated localities. There is also wide variation in the sculpture of the proximal abaxial scales, ranging from smooth, to granular, to bearing low crests. However, in specimens from the northern Gulf of Mexico, the cristate sculpture is reduced in prominence and complexity to a degree not seen in specimens from elsewhere, and these are here treated as a subspecies, *Callogorgia americana delta,* defined in the following pages.

As seen in Table 1, the number of scales per row type varies. This variation occurs not only among different polyps on the same colony, but between the different sides of the same polyp, i.e., one polyp may have 2 outer-laterals on one side and three on the other side.

Although most coenosteal sclerites are flattened, those of some specimens (e.g., *P*-197) are circular in cross-section.

Etymology.—Neo Latin *americanus*, in reference to the "american" distribution of the species, the name first suggested by Kükenthal (1919).

Comparisons.—Well-developed specimens of this species usually can be distinguished from *C. gracilis* by their more widely spaced, more flexible branchlets, zigzag main stems, more prominent whorls of polyps, and generally more plumose aspect, as compared with the more rigid, featherlike colonies of *C. gracilis* with their stiff branchlets and straight main stems. Very large colonies of *C. gracilis* with long branchlets might be confused with *C. americana,* but the sclerites have at most a network of raised ridges, never the high radial crests developed on the abaxial scales of *C. americana.*

Callogorgia americana belongs to the same group of species including *C. flabellum* (Ehrenberg), *C. weltneri* (Versluys), *C. cristata* (Aurivillius), *C. robusta* (Versluys), *C. kinoshitae* (Kükenthal), *C. ramosa* (Kükenthal & Gorzawsky), and *C. gilberti* (Nutting), all from Indo-Pacific localities. As most of those species are known from only one or two specimens, their variability cannot be assessed. When adequate series are available for study, some of these nominal species may fall into synonymy. *Callogorgia americana* most resembles *C. flabellum* (Ehrenberg) as described and illustrated by Versluys (1906), but the cristate sculpture does not persist as far proximad on the proximal abaxial scales as it does in *C. flabellum.* If our interpretation of Versluys' figure of a polyp (1906:70, fig. 75) is correct, his specimen has 10 abaxials, 3 outer-laterals and 2 inner-laterals, rather than 2 outer-laterals and possibly one inner-lateral as he described in text, and therefore corresponds rather closely with *C. americana.* Even though Versluys compared his specimen from the Kei Islands with fragments of Ehrenberg's type specimen in the Berlin Museum, the latter was in such poor condition that he was unable to be sure that they were identical. It is thus by no means certain that Versluys's *Siboga* specimen was correctly identified.

Distribution.—Straits of Florida, from about 28°N southward to the Campeche Bank, Yucatan Peninsula, Mexico; Nicholas Channel; Lesser Antilles from Puerto Rico to Isla de Tortuga, Venezuela (Fig. 4); 183–732 m, but records deeper than 600 m and shallower than 200 m are rare.

Remarks.—Of the five species of *Callogorgia* recognized by A. E. Verrill in his unfinished report on the alcyonarians of the *Blake* explorations, three pertain to the species here described as *C. americana,* which was recorded under the name *Caligorgia verticillata* by Deichmann (1936). As has already been pointed out (Carpine & Grasshoff 1975), *C. verticillata* is an eastern Atlantic and Mediterranean species quite distinct from any western Atlantic species. The origin of this error is traceable to Kükenthal (1919), who used three specimens from Key West ("West Key"), Florida, as the basis for his description of *verticillata.* He also saw some of Verrill's specimens from

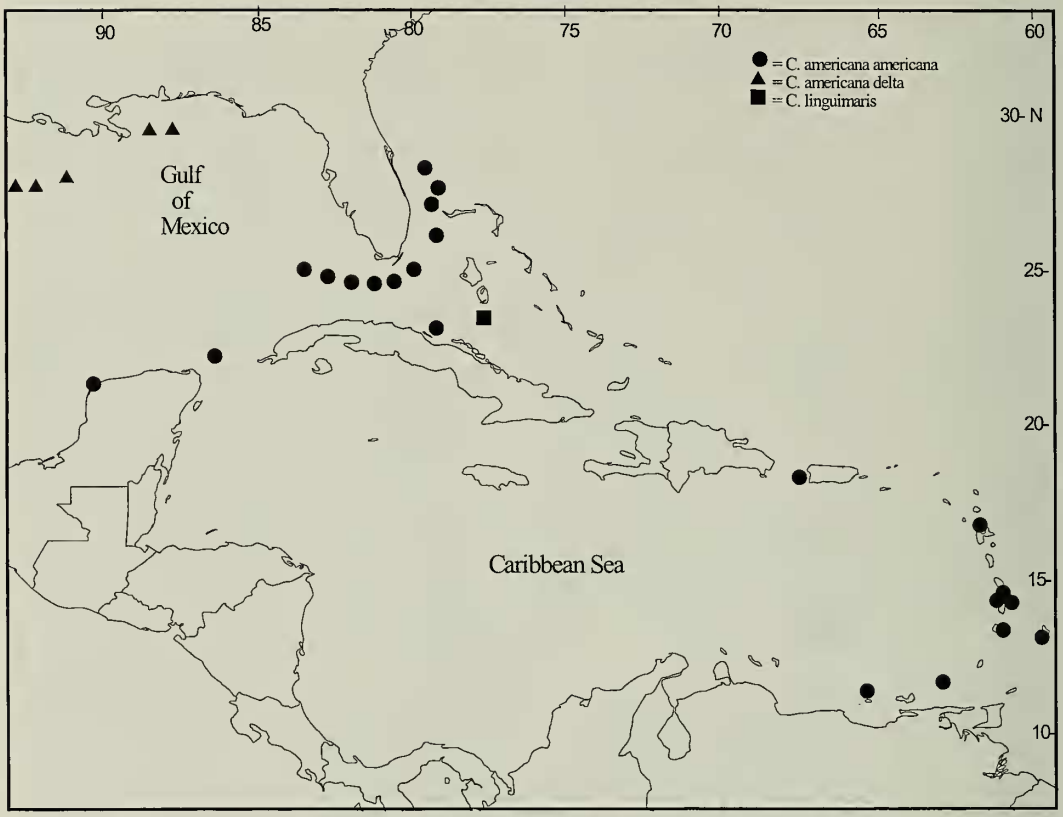

Fig. 4. Distribution of *Callogorgia americana americana, C. americana delta,* and *C. linguimaris.*

Florida (220 m) and St. Lucia (282 m) at the Museum of Comparative Zoology and mentioned that they were labeled "*Callogorgia americana.*" Those specimens were reported as *C. verticillata* by Deichmann (1936:160) and are still preserved at the Museum of Comparative Zoology at Harvard (cat. nos. 4817, 4830).

As a new subspecies of *C. americana* is described below, the previous description applies to the nominate subspecies: *C. americana americana.*

Callogorgia americana delta,
new subspecies
Figs. 1B, 4–6

Callogorgia verticillata.—Bayer, 1958:388 (in part: *O*-817).

Material examined/types (all specimens listed below considered to be syntypes).—GULF OF MEXICO: Green Canyon, Louisiana: 27°46′48″N, 91°33′06″W, 366 m, *JSL-I*-2064, 16 Jun 1987, 1 colony and 2 main branches (dry), USNM 91371 (SEM 1902).

Green Canyon, Louisiana, 27°46′55″N, 91°30′25″W, 546 m, *JSL-I*-3271, 12 Aug 1992, 4 large colonies, USNM 94517.

Green Canyon, Louisiana: 27°45′32″N, 91°13′37″W, 457–472 m, R/V *Citation* sta. 5507, 11 Jun 1985, 1 small colony (dry), USNM 89125.

Green Canyon, Louisiana: 27°44′47″N, 91°13′19″W, 540 m, *JSL-I*-3267, 10 Aug 1992, 2 large colonies, USNM 94516.

Green Canyon, Louisiana: 27°45′N, 91°12.5′W, 440 m, *O*-4708, 23 Feb 1964, 1 main branch with 20 lateral pinnate branches, and 1 detached lateral branch with pinnate branchlets, USNM 52878 (SEM 333, 452).

Off Garden Island Bay, Louisiana: 29°12′N, 88°34′W, 58 m, *O*-817, 5 Aug 1953, 2 main branches, USNM 1003483.

Viosca Knoll, south of Mobile, Alabama: 29°12′N, 88°03′W, 475–570 m, *O*-3651, 25 Jul 1962, 1 main branch with 1 large and two smaller lateral branches with pinnate branches, and several smaller branches with pinnate branchlets, all possibly part of one large colony, USNM 52903 (SEM 208, 453, 461); 1 large branch, RMNH Coel. 31168.

Viosca Knoll, south of Mobile, Alabama: 29°10′N, 88°01.5′W, 570–640 m, *O*-3741, 26 Aug 1962, 2 main branches with lateral branches and pinnate branchlets, severely decorticated during collection, USNM 52877 (SEM 367, 454).

Viosca Knoll 826, south of Mobile, Alabama: 27°09′20″N, 88°01′16″W, 458 m, *JSL-I*-3261, 6 Feb 1992, 2 large colonies, USNM 94515.

Diagnosis.—*Callogorgia americana* with cristate sculpture of abaxial and outer-lateral body scales that is weaker and less complicated than that of nominal subspecies, crests of outer-lateral and distalmost 3–4 abaxial scales consisting of thin, narrow ridges highest along free margin and not so conspicuous on remaining surface; opercular scales when closed forming a taller, more conspicuous cone.

Description.—The plumose, flabellate colonies are like those of typical *C. americana* from localities outside the Gulf of Mexico. They probably attain a similar size, but the largest colony reported herein is only 0.5 m in height (*JSL-I*-3271). The simple lateral branchlets may be as long as 120 mm, but 50–75 mm is more common.

The contracted polyps are 1.3–1.4 mm tall, not so strongly clavate as those of *C. americana americana.* The distalmost whorls are composed of 2 or 3 polyps and some whorls evidently remain indefinitely as pairs, whereas most increase to 3, 4, or even 5 individuals. Four to 6 whorls occur in 1 cm of axial length, but 4 is very common so the colonies are somewhat more delicate in appearance than are typical *americana,* where 5 whorls per cm is common.

As in typical *C. americana,* all eight rows of body scales are present and in roughly the same numbers (Table 1). In this form, however, it is more common to have additional outer-lateral scales adjacent to the most proximal abaxials, disjunct from those near the margin. These additional scales produce a slightly swollen aspect to the base of the polyps.

The cristate sculpture of the distal abaxial and outer-lateral scales is much less prominent and less complex than in typical *C. americana.* On these scales the sculpture is reduced to low ridges extending back from the finely serrate margins, covering only the distal half of the scale; the boundary between abaxial and outer-lateral scales is usually easily seen. Occasionally there are no ridges on the outer-lateral scales at all. Furthermore, the proximal 4 or 5 scales of the abaxial rows lack crests and are only weakly sculptured with fine granules or smooth.

The operculum, when closed, forms a taller, more prominent cone (Fig. 5) than is usual in *C. americana americana* (Fig. 2), the scales being neither so deeply excavated nor so strongly curved inward at the apex. The coenenchyme contains a layer of narrow, somewhat flattened, irregularly fusiform sclerites with sparse granular ornamentation on the exposed surface and crowded complex tubercles on the inner surface.

Etymology.—From *delta,* fourth letter of the Greek alphabet, as used for the alluvial deposit at a river mouth, in allusion to the delta of the Mississippi River, off which specimens were collected.

Comparisons.—*Callogorgia americana delta* resembles the Californian *C. kinoshitae* (Kükenthal), which originally was identified by Nutting (1909) as *C. sertosa* (Wright & Studer), a species from the Kei Islands with which it has nothing at all to do. Although Kükenthal (1913) reported

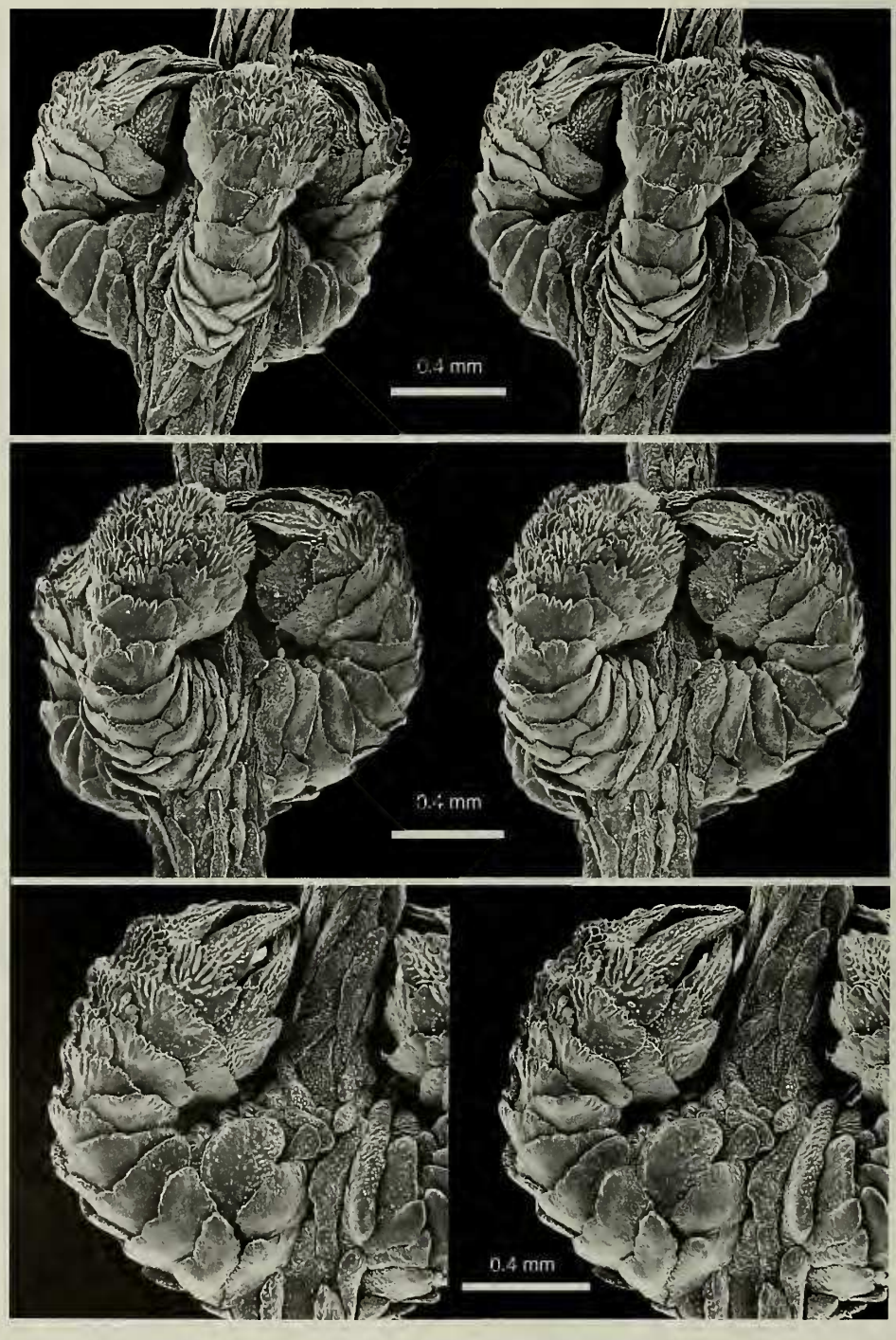

Fig. 5. *Callogorgia americana delta* from *O*-3651, USNM 52903: three stereo views of the arrangement of sclerites covering the polyps and stem, upper two pairs (× 40), lower pair (× 46).

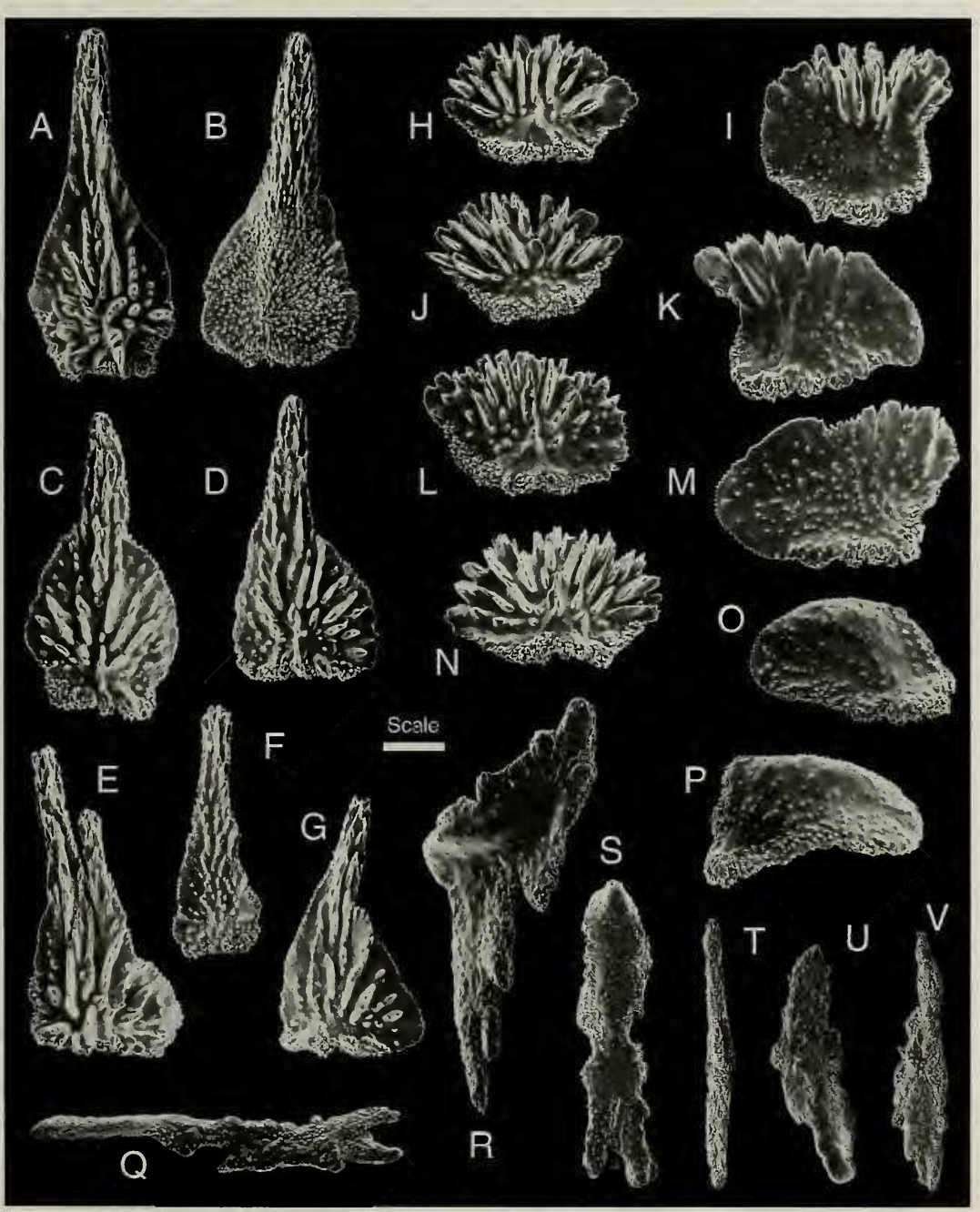

Fig. 6. Sclerites of *Callogorgia americana delta* from *O*-3651, USNM 52903: A–G, opercular scales (F is an adaxial opercular); H, J, L, N, abaxial scales near tip of polyp; I–K, outer-lateral scales; M–O, inner-lateral scales; P, abaxial scale near base of polyp; Q–V, flattened coenenchymal rods. All views are of external surface, except figure B. Scale bar: A–P, R = 0.10 mm, Q, S–V = 0.20 mm.

that in *C. kinoshitae* the four abaxial rows of scales (i.e., both abaxial and outer-lateral rows) each contain 7–8 scales, material available to us has that many only in the 2 abaxial rows, with only 3 in the outer-lateral and 1 or 2 in the inner-lateral rows. Thus, *C. kinoshitae* seems to be not very different from *C. americana delta* as regards measurable characters, but differs with respect to external ornamentation of the body scales, which are sculptured with granules more conspicuously than in specimens of *delta*. It is possible that *C. kinoshitae* is the eastern Pacific analogue of *C. americana delta,* but any conclusion about their relationship would be premature without a detailed study of much more material than is available at present.

Distribution.—Northern Gulf of Mexico off Louisiana (Green Canyon) and Alabama (Viosca Knoll) (Fig. 4); 366–570 m, with one odd record from 58 m (*O*-817).

Remarks.—Although *C. americana delta* might be considered a distinct species, it agrees with *C. americana* in most traditionally accepted characters, such as: number of abaxial scales, outer-lateral scales, and inner-lateral scales, range of whorls per cm, and type of sculpturing on the abaxial and outer-lateral scales (Table 1). However, in addition to the geographic separation, subspecies *C. a. delta* consistently differs from the typical form in having a reduced adaxial sculpture (lower, less complex, less coverage of scale). Furthermore, *C. a. delta* appears to have taller opercular scales, fewer polyps per whorl, and a slightly lower average number of whorls per cm. Therefore, we consider it preferable to treat the populations from the northern Gulf of Mexico as a subspecies of the widespread Caribbean species.

Callogorgia linguimaris, new species
Figs. 1C, 4, 7–8

Material examined/holotype.—TONGUE OF THE OCEAN: Great Bahama Bank, 23°29′N, 77°09′W (type locality), 1116 m, *CI*-15, 5 Jul 1972, 3 damaged pinnate branches (all from same colony), USNM 94580 (SEM 499, 503, 808, 810, 811, 814, 817).

Diagnosis.—*Callogorgia* with low crest-like radial sculpture only on distalmost abaxial scales, remaining body wall scales smooth. 5–7 body scales in abaxial row, 1–2 in outer-lateral rows, 1–2 in inner-lateral rows, and usually one in adaxial position; usually 2 polyps per whorl, on opposite sides of branchlet.

Description.—The syntypic series consists of three branches, 14, 12, and 8.5 cm in height, undoubtedly part of the same colony that once measured 22 cm in height, but was broken near the base during collection, the base being 2.7 mm in greater diameter. Branching is alternate pinnate, the longest branchlet being 60 mm in length, the distance between branchlets on one side ranging from 10 to 12.5 mm. The main axis bends slightly away from point of origin of each lateral branchlet, thus following a slightly zigzag (quasisympodial) course.

Polyps in contraction are bent strongly inward toward the axis, cylindrical to slightly clavate, up to 1.1 mm in height, and arranged in pairs on opposite sides of the branchlet, although whorls of 3 are sometimes found toward the base of the branchlets, and single polyps are also rarely present. Polyps on the main stem are arranged in a random fashion. Four pairs or whorls of polyps occur per cm.

All 8 longitudinal rows of body scales are present in each polyp: 5–7 scales in each abaxial row, 1 or 2 in each outer-lateral row, 1 or 2 in each inner-lateral row, and 1 in each adaxial position. Disjunct, proximal outer-lateral scales were not noted. The abaxial body scales are usually not paired across the sagittal axis, rather they alternate in position and slightly overlap. Except for the marginal abaxials, the outer surface of these scales is virtually smooth, often lacking even granulation; however, the distal margin of the marginal abaxials is serrate, bearing low ridges that are con-

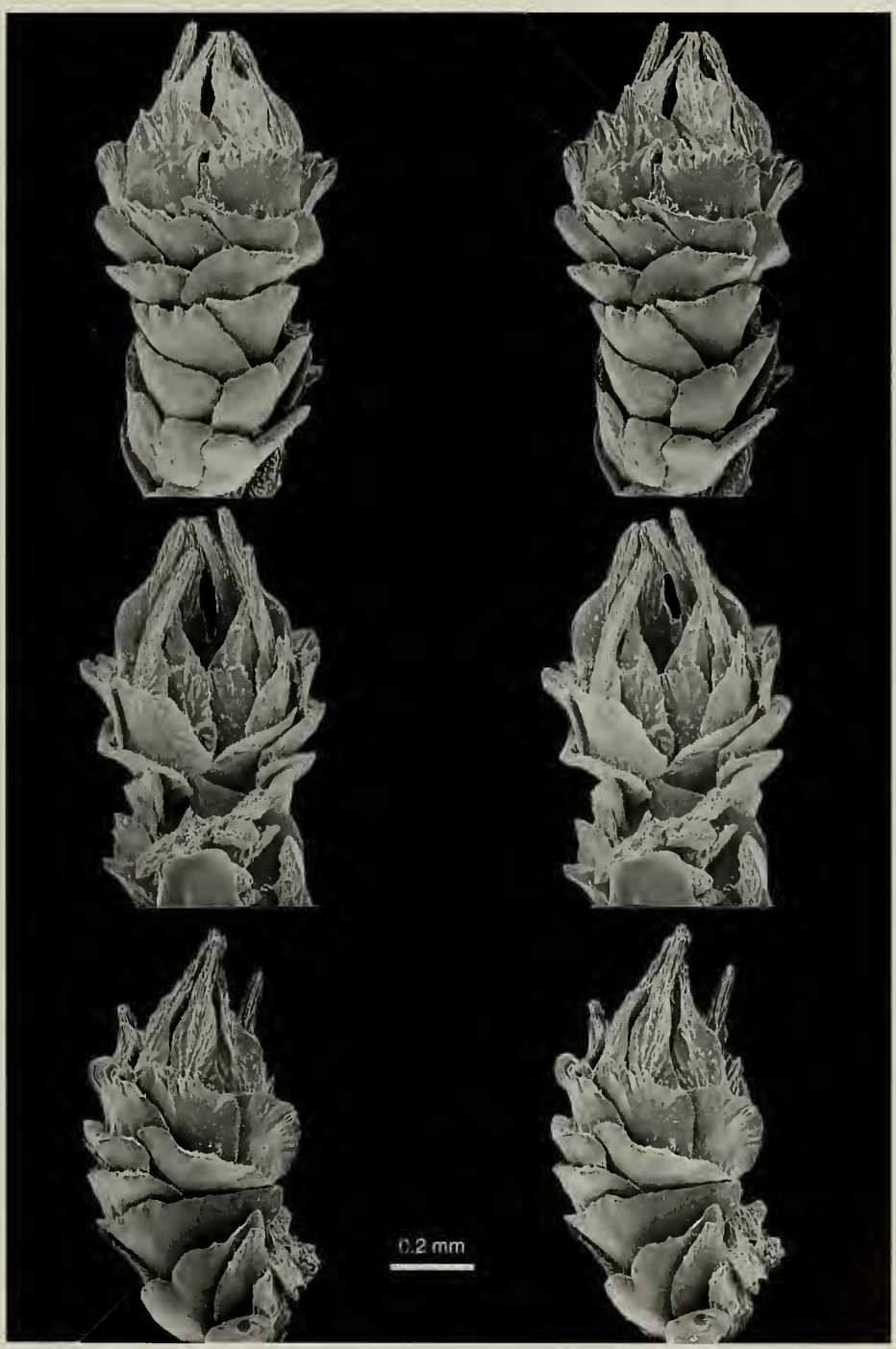

Fig. 7. *Callogorgia linguimaris* from *CI*-15, USNM 94580: three stereo views (abaxial, adaxial, lateral) of the arrangement of sclerites covering a polyp, scale bar applies to all three views (× 59).

tinuations of ridges on the internal surface of these scales. In fact, the internal ridges are so prominent that they prevent these scales from lying flat, causing them to slightly flare outward. The outer and inner-lateral scales, although few in number, are quite broad and also smooth. The adaxial pair is small and often covered by the adaxial edge of the adjacent inner-lateral scales.

The operculum is well developed, tall, and triangular. The opercular scales are narrow triangles with weakly concave sides, externally ornamented by several low radial crests and small spines, the upper margin of the operculars finely serrate. The adaxial operculars are smaller than the other 6 (Fig. 8E–F), whereas the inner-lateral operculars have a broad base and very narrow apical region (Fig. 8A–B).

Coenenchymal sclerites are elongate (up to 0.60 mm), irregular, flattened rods or spindles sometimes branched or lobed, crowded but not closely fitted as in mosaic. Coenenchymal sclerites are externally sculptured with scattered sharp granules.

Variation.—It was noted that the sculpturing of the body wall scales on the polyps on the main stem is much better developed than on the branchlet polyps. The marginal abaxials of the polyps occurring on the stem bear tall, serrate ridges that cover the entire outer surface (Fig. 8H), and the two tiers of scales proximal to those scales also bear prominent distal ridges.

Etymology.—From Latin *lingua* = tongue + *mare,* genitive *maris,* the sea, in allusion to the type locality.

Comparisons.—Although the colonies of *C. linguimaris* are of the *americana* type and the polyps resemble the more weakly-sculptured individuals found in *C. americana delta,* the tall, conical operculum is conspicuously different and the margins of the body scales are distinctly flared outward. Moreover, the abaxial body scales near the base of the polyps do not assume the wide, embracing form present in *C. americana americana* and *C. americana delta. C. linguimaris* is also distinctive in having only two polyps per whorl (Table 1).

Distribution.—Known only from the type locality, which is the deepest known record of a *Callogorgia* from the western Atlantic (Fig. 4).

Remarks.—*Callogorgia linguimaris* is represented by only a single damaged specimen taken by fish-trawl in the Tongue of the Ocean, so little can be said about variation. It can be seen, however, from even this scanty material, that the sculpture of the body scales varies with respect to the strength of sculpturing, even from one polyp to another on the same branch. The arrangement of body scales also is inconsistent, in that the scales of the outer-lateral and inner-lateral rows may be present or absent, and in some cases it is difficult to determine to which row a given scale belongs.

Callogorgia gracilis
(Milne Edwards & Haime, 1857)
Figs. 1D, 9–11

Primnoa gracilis Milne Edwards & Haime, 1857:141.—Duchassaing & Michelotti, 1860:17 (listed).

Callogorgia gracilis: Gray, 1859:484.

Calligorgia verticillata: Gray, 1870:35 (in part: "West Indies" type).

Caligorgia gracilis: Wright & Studer, 1889: 78 (listed).—Versluys, 1906:65–66, fig. 70.—Kükenthal, 1919:375, pl. 40, fig. 49; 1924:273–274.—Deichmann, 1936: 158–159 (in part: MCZ 4791, 4793–6, pl. 25, figs. 4, 10–11, pl. 26, fig. 7).—Bayer, 1954:281 (listed).

Material Examined.—GULF OF MEXICO: Diaphus Bank: 28°05′N, 90°41′W, sub dive 119, 16 Oct 1978, 1 branch, TCWC 5-0836.

BAHAMAS: NW of Little Bahama Bank: 27°55.8′N, 79°09′W, 370 m, *Alvin* dive 77-746, May–Jun 1977, 2 large pinnate branches and some fragments, all apparently from one colony, USNM 58934 (SEM 471, 493).

Off NW corner, Little Bahama Bank:

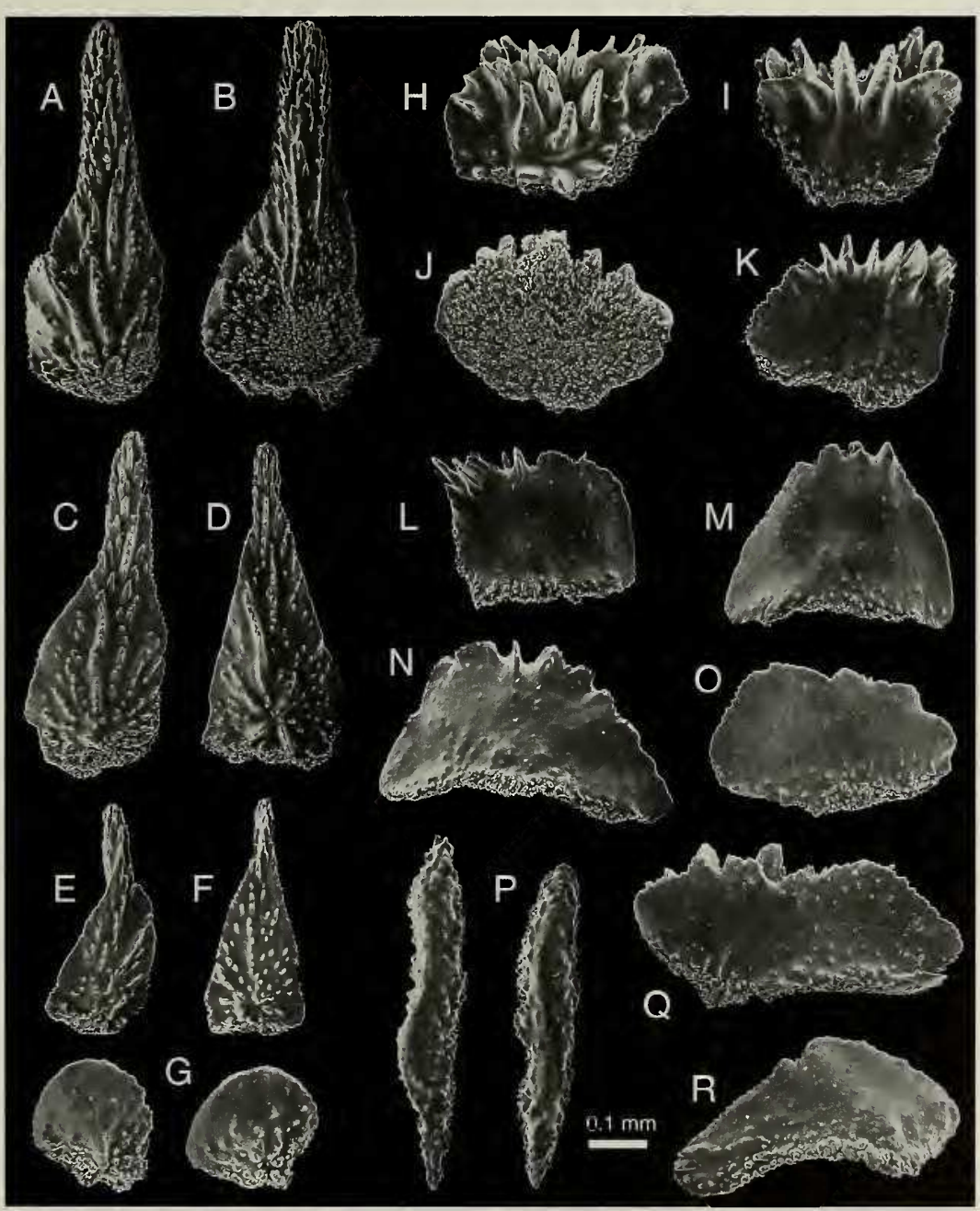

Fig. 8. Sclerites of *Callogorgia linguimaris* from *CI*-15, USNM 94580: A–F, opercular scales (E–F are adaxial operculars); G, two adaxial scales; H–I, abaxial scales near tip of polyp; J–K, outer-lateral scales; L–M, O, inner-lateral scales; N, Q, R, abaxial scales near base of polyp; P, two coenenchymal rods. All views are of external surface, except figures B and J. Scale bar applies to all figures.

27°27′N, 79°00′W, 229–275 m, *SB*-3467, 25 Oct 1961, 1 colony and detached twigs, USNM 52933 (SEM 475, 476).

Off Matanilla Reef, Little Bahama Bank: 27°25′N, 78°48′W, 293–311 m, *G*-251, 5 Feb 1964, several large pinnate branches entwined with ophiuroids, all possibly belonging to 1 large colony, together with many smaller fragments, USNM 52943 (SEM 327, 328, 502).

North of Little Bahama Bank: 27°18′N, 79°13′W, 370 m, *Eastward*-26549, Mar 1975, 1 branch, USNM 59132.

Off NW corner, Little Bahama Bank: 26°53′N, 79°07′W, 320 m, *Eastward*-31281, 3 branches, USNM 94556.

West of Grand Bahama: 26°42.56′N, 79°02.39′W, 376 m, *JSL-I*-1354, 13 Jun 1983, 1 branch, USNM 1003992 (SEM 1778).

West of Grand Bahama: 26°42.55′N, 79°01.72′W, 302 m, *JSL-I*-1357, 14 Jun 1983, 3 branches, USNM 1003994 (SEM 1784, 1797, 1846).

West of Grand Bahama: 26°41.8′N, 79°01.3′W, 260 m, *JSL-I*-1355, 13 Jun 1983, 3 branches, USNM 1004025 (SEM 1783).

West of Grand Bahama: 26°40.49′N, 79°00.42′W, 304 m, *JSL-I*-1360, 16 Jun 1983, 4 branches, USNM 1004026 (SEM 1768, 1764).

Northwest Providence Channel: 26°31′N, 78°51′W, 366 m, *G*-503, 4 Feb 1965, 3 pinnate branches, USNM 52942 (SEM 229, 469, 470); 3 pinnate branches, USNM 52944 (SEM 319, 320, 396); 2 pinnate branches and fragments, USNM 58395.

Northwest Providence Channel: 26°28′N, 78°40′W, 278–329 m, *G*-526, 3 Mar 1965, 1 pinnate branch, USNM 52923 (SEM 201–203).

Northwest Providence Channel: 26°34′N, 78°25′W, 329–421 m, *G*-692, 21 Jul 1965, main stem with holdfast and several large pinnate branches, all possibly part of 1 colony, USNM 52946 (SEM 234, 235, 449).

Northwest Providence Channel: 26°27′N, 78°40′W, 514–586 m, *G*-707, 22 Jul 1965, 1 small colony with holdfast attached to fragment of echinoid test, USNM 52940 (SEM 228).

Southeast of San Salvador: 24°04.6′N, 74°33.12′W, 345 m, *JSL-I*-1504, 24 Oct 1983, 1 branch, USNM 1004027 (SEM 1780, 1847).

South of San Salvador: 23°55.28′N, 74°33.42′W, 292 m, *JSL-I*-2006, 23 Apr 1983, 3 branches, USNM 1004039 (SEM 1836, 1845).

Off Great Inagua: 20°54′N, 73°33′W, 175–200 m; *O*-5423, 26 May 1965, 5 fragments, USNM 59089 (SEM 473).

HISPANIOLA: Off Navidad Bank, Dominican Republic: 20°11.0′N, 68°52.9′W, 180 m, *P*-1410, 17 Jul 1971, 1 pinnate branch, USNM 52919.

LESSER ANTILLES: Off Fort de France Bay, Martinique: 14°32.6′N, 61°06.2′W, 51–82 m, *P*-910, 10 Jul 1960, 1 pinnate branch, USNM 52924 (SEM 331).

Barbados: 13°04.5′N, 59°39.5′W, 183–146 m, *O*-5016, 20 Sep 1964, 2 large and several smaller pinnate branches, all probably part of one colony, USNM 52918 (SEM 345, 483, 490).

VENEZUELA: North of Peninsula de Paria: 11°07′N, 62°14′W, 134 m, *Alb*-2120, 30 Jan 1884, 2 branches, USNM 7066 (SEM 1705, 1706).

HONDURAS: Near Thunder Knoll: 16°35′N, 80°55′W, 183 m, *O*-1890, 24 Aug 1957, 4 branches, USNM 59278.

All twelve lots reported by Deichmann (1936), only 5 of which are considered to be *C. gracilis sensu stricto* (see synonymy) (SEM 1855–1866).

Holotype, MNHNP and USNM (see below).

Types/type locality.—"Guadeloupe", Lesser Antilles (restricted type locality, as determined from label with holotype), coll. L. Rousseau, 1840, 3 small branch fragments of the holotype, USNM 59095 (SEM 442, 443), the remainder of which is deposited in the Muséum National d'Histoire Naturelle.

Diagnosis.—*Callogorgia* with all body

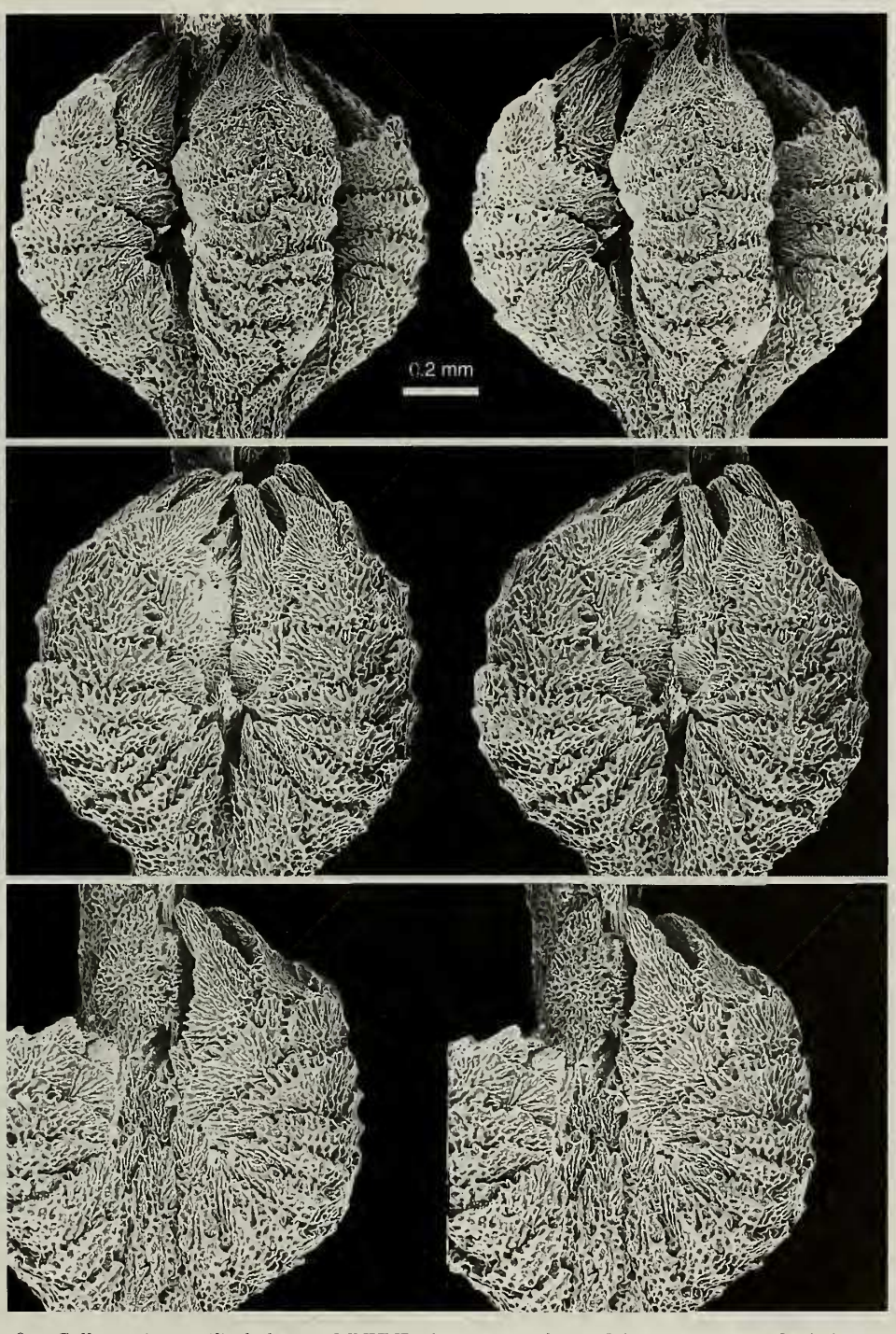

Fig. 9. *Callogorgia gracilis*, holotype, MNHNP: three stereo views of the arrangement of sclerites covering the polyps, scale bar applies to all three views (× 55).

scales externally sculptured with low, narrow, reticulating ridges; 5–8 scales in abaxial rows; one scale (sometimes two or none) in outer-lateral rows, no inner-laterals, and usually no small adaxial scales; 4–8 whorls of polyps in 1 cm of twig length.

Description.—The rather stiff, pinnately-branched, flabellate colonies may be 1 m or more in height, branched in a regular, alternate pinnate manner. The undivided lateral branchlets vary in length from 35 to 170 mm depending, in part, upon the size of the colony; in most specimens they are between 50 and 90 mm long. In rather few colonies are the branchlets more than 90 mm long, and in fewer still (and those obviously young) are they shorter than 40 mm. The relationship between overall height and length of lateral branchlets seems to be variable. Some large colonies have branchlets only 50–60 mm long, whereas others may have branchlets 80–90 mm long, but the broken condition of most dredged specimens precludes meaningful analysis. The distance between branchlets along one side of the stem (i.e., internodal distance ×2) ranges between 4.5 and 11 mm, but in most colonies is 5–8 mm; only rarely is the distance as great as 10–11 mm. The direction of the main axis changes little, if at all, at the origins of the lateral branchlets, so the stems are straight.

Polyps are strongly bent inward toward the axis, are cylindrical (not clavate), and 0.9–1.1 mm in height. The number of polyps per whorl varies from 2 to 6, but pairs (i.e., whorls of 2 individuals) are usually confined to the distalmost part of the branchlets, and whorls of 5 or 6 generally are found on the lower, older branchlets. The spacing of whorls along the branchlets varies from 4 to 8/cm, but 6 or 7/cm is usual.

Only 4 longitudinal rows of body scales are usually present (abaxial and outer-lateral), the scales of both outer- and inner-lateral and adaxial rows being reduced in number as a consequence of the curvature of the polyps toward the axis. One or 2 small marginal scales may be present in the adaxial rows but commonly are absent. The inner-lateral rows are always absent. The outer-lateral rows are usually represented by only one marginal scale; in a very few colonies (e.g., USNM 44133) 2 outer-lateral scales are present in some but not all polyps; and occasionally there are no outer-lateral scales. Two opercular scales usually articulate with the outer-lateral marginal, but when the outer-lateral marginal is absent (e.g., USNM 52942, 52944), the outer-lateral marginal position is occupied by a wide lateral expansion of the abaxial marginal, with which 3 opercular scales articulate. And in some cases, the absence of the outer-lateral marginal scale is compensated for by the broadly rounded basal lobe of the corresponding opercular scale as in USNM 52923 and 52944. The absence of the outer-lateral marginal might be the result of fusion of that scale with either the first or second abaxial, or with the outer-lateral opercular scale. Sometimes 1 or 2 additional outer-lateral scales are present at the base of the polyp (the outer-lateral 6 or 7 position), disjunct from the marginal scales.

The entire outer surface off all body scales and coenenchymal plates is delicately sculptured with more or less conspicuous ridges that radiate from a central region and sometimes anastomose, forming small polygonal cells as in a honeycomb. The distal edges of the body scales are finely serrate, the result of prominent ridges on the under side of the sclerite, but which do not extend to the outer surface of the scale. These ridges of the distal margin interlock with the external ridges and grooves of the proximal part of the next following scale. The inner surface is also covered with complex tubercles.

The opercular scales vary from nearly flat to strongly incurved; the apical tooth may be slender and rather sharp or stout and blunt, but always has distinct longitudinal ridges. The margins may be nearly smooth, or more or less distinctly serrated, especially along the slope of the apical

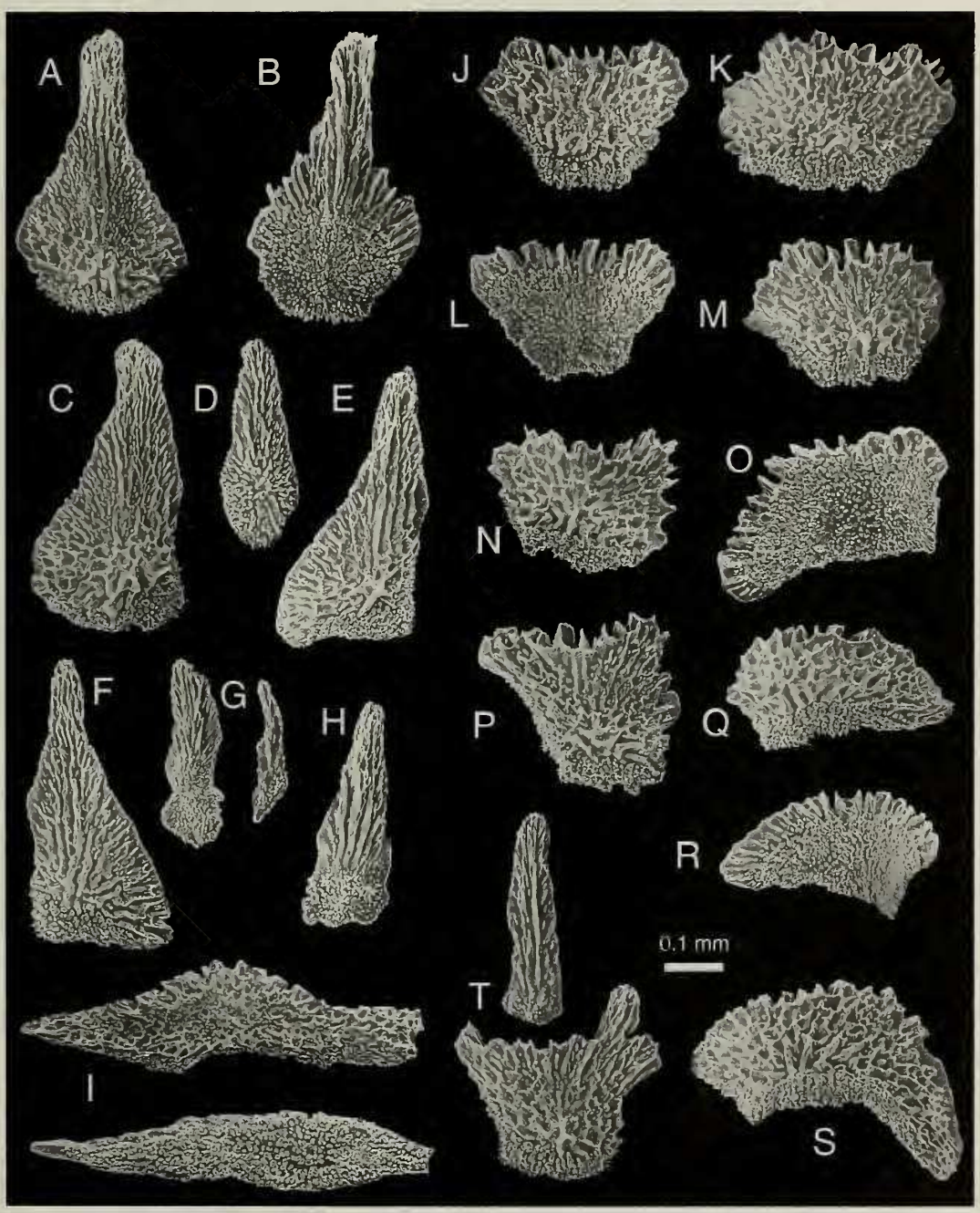

Fig. 10. Sclerites of the holotype of *Callogorgia gracilis*: A–H, T, opercular scales (G are two adaxial operculars; T developed in a disjunct fashion); J–S, adaxial scales showing characteristic reticulate sculpture (S near base of polyp); I, two flattened coenenchymal rods. All views of external surface except figures B, I (lower), L, O, and R. Scale bar applies to all figures.

tooth. The outer face of the larger opercular may be somewhat concave on the base of the apical tooth, but there is never a sharp keel on the inner surface. The tentacles contain numerous minute rods that seem to have no practical taxonomic value.

Comparisons.—As Versluys (1906) pointed out, *C. gracilis* resembles *C. verticillata* of the eastern Atlantic and Mediterranean Sea in the form of its polyps and external sculpturing of its sclerites. Material available to us is inadequate to determine whether or not *C. verticillata* varies with respect to these characters as much as does *C. gracilis.* Certainly the specimen from Meteor Bank provided by Dr. M. Grasshoff differs from that illustrated by Carpine & Grasshoff (1975: fig. 57) in much the same way that two Caribbean specimens of *gracilis* may differ.

From our own observations, *C. verticillata* has 7–8 scales in the abaxial rows, 3–4 in the outer-laterals, 2 in the inner-laterals, and 1 in the adaxial rows. According to Carpine & Grasshoff (1975), their material had 8–10 abaxials, 8 outer-laterals, 4 inner-laterals, and 2 adaxials. Versluys (1906) described 8–9 abaxials, with well-developed outer-lateral rows and the inner-laterals present in unspecified numbers. It therefore is clear that *C. verticillata* consistently differs from *gracilis* by the presence of inner-lateral scale rows and stronger development of the outer-lateral rows. It may vary as extensively as does *C. gracilis,* as Versluys' (1906) account of *C. grimaldii* indeed suggests.

Distribution.—An essentially insular distribution (Fig. 11) extending from the northernmost Bahamas throughout the Antilles, and off Honduras; also Diaphus Bank, Gulf of Mexico; 82–514 m.

Remarks.—A small fragment of the type specimen in the Paris Museum was described by Versluys (1906) to augment the inadequate original description provided by Milne Edwards & Haime. Another twig of the type received through the kindness of Mme. Marie-José d'Hondt agrees in all respects with Versluys' description (1906) and provides the basis for the accompanying SEM micrographs of the polyps and sclerites (Figs. 9–10). He established that the species has 7 whorls of 2–4 polyps each in 1 cm of axial length, 7 scales in the abaxial rows, and one in the outer-lateral rows. Unfortunately, he illustrated only a single coenenchymal scale, but no body scales nor an intact polyp. We can confirm Versluys' observations and present illustrations of both polyps and isolated sclerites. On our holotypic fragment (USNM 59095) of a lateral branchlet there are 8 whorls of polyps in 1 cm of twig length, and the whorls consist of 3 polyps each. The polyps (Fig. 9) have 6–8 body scales in the abaxial, one only (the marginal) in the outer-lateral rows; inner-lateral and adaxial rows often are not represented. The arrangement of body scales and the reticulate ornamentation of the sclerites mentioned by Versluys are clearly revealed by SEM (Figs. 9–10). The overlapping dentate distal margin of the body scales is flared outward, exposing the sharp internal crests leading to the marginal dentations. Complex tubercles cover the inner surface of the body sclerites as well as that part of the proximal margin covered by the scale below. The coenenchymal sclerites are elongate, tapered flat rods with reticulate outer ornamentation and crowded tubercles on the inner surface; broader scales as observed by Versluys are present but uncommon on the distal twigs.

Kükenthal (1919, 1924) accepted the taxonomic characters recognized by Versluys and incorporated them in his keys and descriptions, and was followed by Deichmann (1936). Verrill (unpub.), however, had earlier observed among the *Blake* alcyonarians five forms of *Callogorgia,* to which he assigned names in manuscript, one of them *C. gracilis* (Milne Edwards & Haime). That and one other were later referred by Deichmann (1936) to *C. gracilis* and remain referable to that species as here defined. The three others were lumped together under the

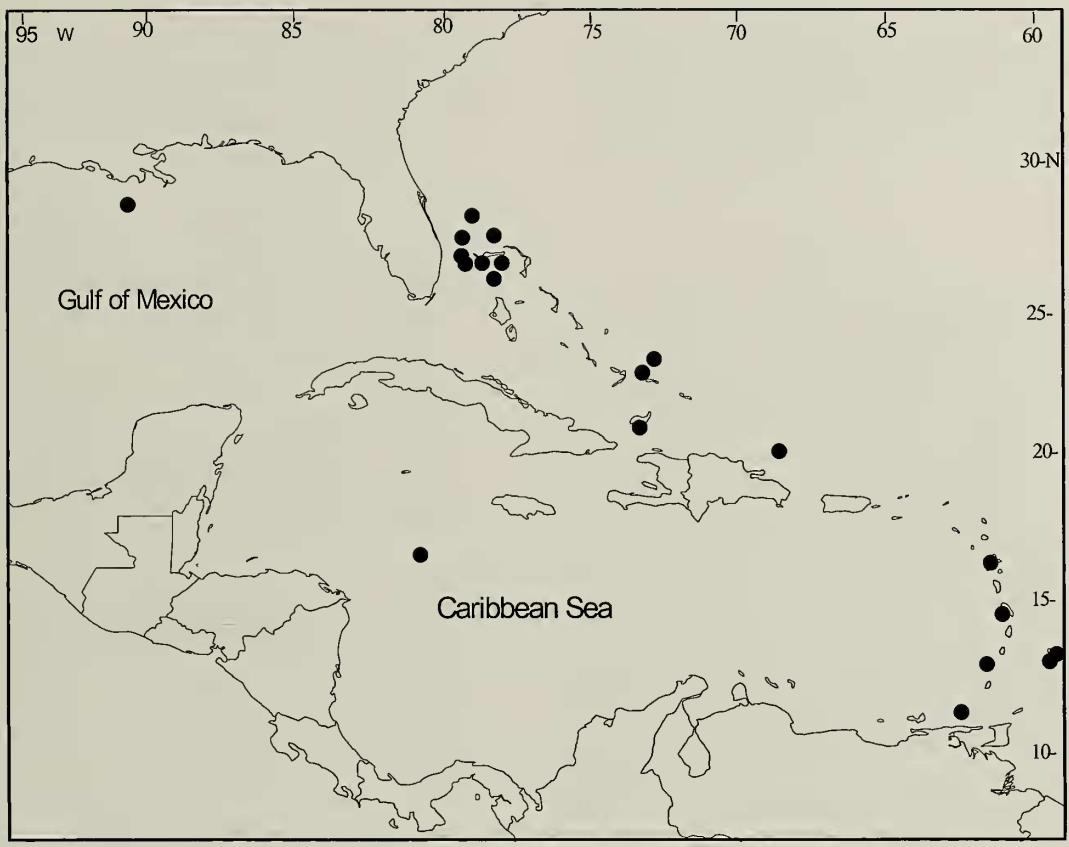

Fig. 11. Distribution of *Callogorgia gracilis.*

incorrect name *C. verticillata,* which she derived from Kükenthal (1919, 1924).

Deichmann's (1936) illustrations of *Callogorgia gracilis* do not adequately express the characters mentioned in her description. All 12 specimens of *C. gracilis* listed by Deichmann (1936) have been examined by SEM, five of them resembling the type specimen (see synonymy). The other specimens identified as *C. gracilis* by Deichmann and several identified by Bayer (1961) as *C. verticellata* differ from the type more noticeably and may fall outside the range of individual variation. The most conspicuous variation (but least subject to analysis) is seen in the external sculpturing of the sclerites. This varies by almost imperceptible gradations from the prominent system of anastomosing raised ridges present on both body and coenenchymal scales of the type specimen, to the externally smooth body scales and weak reticulated wrinkling of the coenenchymal scales observed in specimens from many localities. The strength of the interlocking marginal dentition, especially of the body scales, varies along with the surface sculpture. Because of the continuous intergradation among these variations, it has proved to be impossible to divide *Callogorgia gracilis* into subspecies. Taken collectively, Deichmann's specimens conform to the key characters given and to the written description of *C. gracilis.* Taken individually, several of the specimens could be regarded as distinct species. However, the morphological characters are so subtle and the large number of specimens now available for study includes so many intermediates that the possibility of a morphological continuum

cannot be ignored. Only after an intensive analysis of a large number of specimens from a wide geographic and bathymetric range will it be possible to evaluate the significance of these morphological differences.

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